2003. The Journal of Arachnology 31:433–436

SHORT COMMUNICATION

BURROW USE IN A NORTHERN CALIFORNIA POPULATION OF THE WOLF SPIDER *SCHIZOCOSA MCCOOKI* (ARANEAE, LYCOSIDAE)

K. Blake Suttle: Department of Integrative Biology, University of California, Berkeley, CA 94720-3140 USA. E-mail: kbsuttle@socrates.berkeley.edu

ABSTRACT. Observations on the wolf spider *Schizocosa mccooki* in northern California grasslands reveal previously unreported burrowing behavior, known to occur in only one other member of the genus. Adult and penultimate female *S. mccooki* may occupy burrows that vary widely in depth and the occurrence of silk linings. Mark-resight techniques revealed burrow fidelity spanning several weeks for individual spiders. Behaviors such as courtship and prey consumption can occur at, but are not restricted to, the entrances to these burrows. Burrows appear to offer daytime shelter for *S. mccooki*, though it remains unclear whether protection from predators or amelioration of abiotic conditions is the primary basis for burrow use.

Keywords: Burrow use, northern California, lycosids

Burrows may offer spiders protection from predators, amelioration of climatic stresses, and a concealed location from which to ambush prey. Burrowing has been reported in many genera of wolf spiders, and it appears to have evolved several times independently in the family Lycosidae. In North America, all the *Geolycosa* (Wallace 1942) and certain members of the *Arctosa* (Kaston 1948), *Alopecosa* (Emerton 1919), *Gladicosa* (Montgomery 1904; Brady 1986), *Hogna* (Wallace 1942; Shook 1978), *Rabidosa* (Kaston 1948) and *Schizocosa* (Dondale & Redner 1990) engage in some form of burrowing behavior. While some authors have presented burrowing as a conserved character at the generic level (Zyuzin 1990; Zehethofer & Sturnbauer 1998), it should be applied with caution as a trait for phylogenetic analysis; our understanding of the prevalence and form of this behavior across the subfamilies, genera, and species of Lycosidae is quite limited, and in some published reports is highly contradictory (e.g. Zyuzin 1990; Zehethofer & Sturnbauer 1998). Observations on the wolf spider *Schizocosa mccooki* (Montgomery 1904) highlight the current scientific ambiguity over this behavior.

Kaston (1972) states that members of the genus *Schizocosa* "do not dig holes in the ground, but are found running about over the surface." Dondale & Redner (1990), however, report burrow construction and use by large juveniles and adult females in Canadian populations of *Schizocosa avida* (Walckenaer 1837). To date, this is the only report of burrow use in the genus. I report here on observations of burrow use and measures of burrow fidelity in a northern California population of *S. mccooki*.

Schizocosa mccooki is a widespread, medium-sized wolf spider, with female length 9.6–22.7 mm (Dondale & Redner 1990). It occurs from the Yukon Territory and British Columbia south to Mexico and east to Texas, Michigan, and Ontario (Dondale & Redner 1978, 1990). Habitat association in *S. mccooki* varies with geographic locale; the species has been collected in dry grassland in Saskatchewan (Buckle 1972), in sagebrush meadows in Idaho (Allred 1975), among grasses and sedges on sand dunes on the shores of Lake Erie (Dondale & Redner 1978), on open ground and desert shrubs in pinyon pine-juniper woodland in New Mexico (Stratton and Lowrie 1984) and in grass and mixed-grass/shrub habitats in the shortgrass steppe in Colorado (Weeks & Holtzer 2000). It has never been reported to use burrows.

Schizocosa mccooki is abundant and widespread at the Angelo Coast Range Reserve in Mendocino County, California (39°43′45″N, 123°38′40″W; elevation ca. 400 m). The Reserve covers over 3000 hectares of protected old-growth Douglas fir and redwood forest, interspersed with mixed oak woodland and grassy meadows along a 5 km reach of the South Fork Eel River. *Schizocosa mccooki* occurs primarily in the meadows and along the meadow-forest boundary, but it has also been observed in forest and riparian habitats. Mature males are found from early June through August and mature

females are common from early June to mid-September and have been found as late as November.

During the summers of 1999–2002, I observed a total of 41 individuals partially concealed in burrows (Fig. 1), defined here as excavated retreats in the soil with diameter 7–18 mm. Although wolf spiders commonly retreat under cover and into crevices and holes when pursued for collection, these were all unmolested individuals. All *S. mccooki* observed in burrows were penultimate and adult females, many carrying egg sacs. One individual was observed consuming a katydid (Orthoptera, Tettigoniidae) at the entrance to a burrow and another a crane fly (Diptera, Tipulidae). Courtship took place at another burrow; a male faced a female partially concealed in the burrow from a distance of approximately two centimeters and performed palpal movements similar to those described in Stratton & Lowrie (1984). All burrows were in the meadow or along the meadow-forest margin, and many were lined with silk (Fig. 2). The 41 females I observed in burrows composed a small percentage ($< 10\%$) of the total number of individuals observed in surveys ($n > 430$). Most female and all male *S. mccooki* observed in the field were wandering on the ground.

After initial observations of burrow-inhabiting individuals in the summer of 1999, I subsequently observed marked individuals to determine whether burrows were occupied briefly, in the course of a night's foraging, or consistently, as a central-place refuge. During the summer of 2000 and 2001, I recorded all instances of burrow use observed in *S. mccooki* and measured the duration of burrow occupancy. Whenever I found a spider in or immediately adjacent to a burrow, I marked the burrow with a flag and the female's anterior legs with fluorescent powder. The powder was sprayed from a distance of several centimeters through a modified syringe to minimize disturbance to the spider. I reexamined burrow entrances each of the next two nights, and then on nights five, six, ten, 11, 20 and 21. I conducted the surveys at night because I found that spiders occupied burrow entrances more commonly at night than during the day.

I marked a total of 16 burrows and occupant females on eight nights in June and July 2000 and 2001. The original spiders occupied the entrances to 13 of these burrows during the next two nights, 11 of the burrows on nights five and six, nine on nights ten and eleven, and three on nights 20 and 21. It is unknown whether individuals absent from burrow entrances were concealed inside, wandering outside, or dead.

To help resolve this question and to examine burrow architecture, I excavated 12 burrows with a hand shovel the day after observing an individual at a burrow entrance in August 2002. Burrows ranged from 6–21 cm in depth, and none were branched. I excavated six of these burrows in the early afternoon and six in the late evening. I located spiders concealed inside five of the six burrows excavated in the afternoon, suggesting that burrows provide daytime shelter to *S. mccooki*. The evening excavations revealed spiders at the entrances to two burrows, concealed inside one burrow, and absent altogether from three burrows. This suggests that *S. mccooki* may wander and return rather than occupy burrows continuously, however no dye-marked individuals in the previous two summers were observed away from burrows.

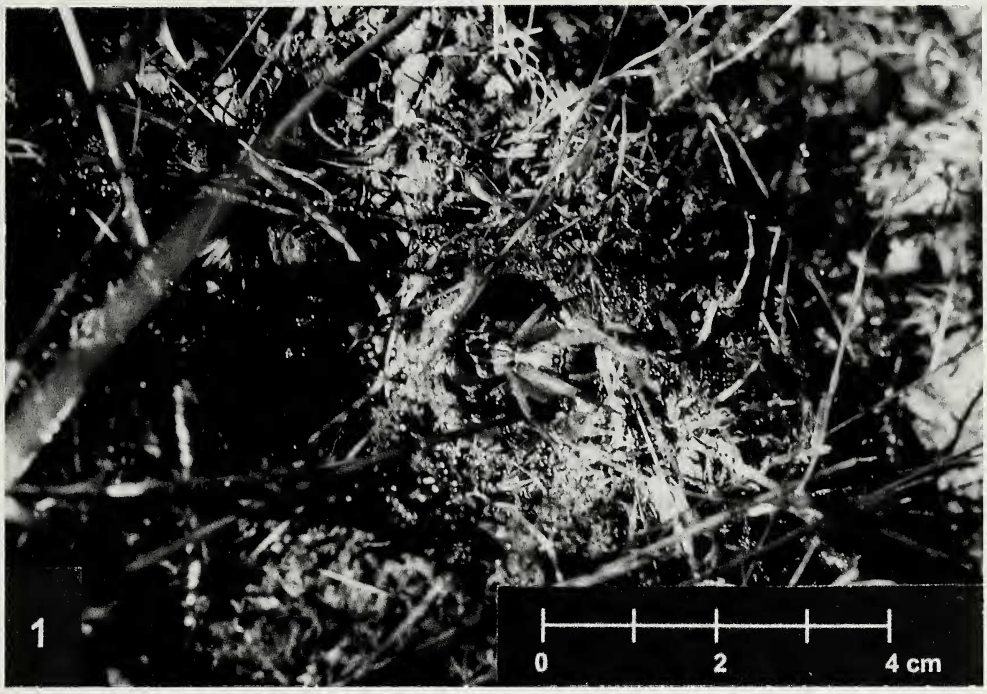
Although many female *S. mccooki* were seen in and adjacent to burrows, no excavatory activity was ever observed. It thus remains uncertain whether *S. mccooki* is a primary excavator or a facultative user of burrows excavated by similarly sized organisms such as wasps. No other burrowing wolf spiders are known at the study area. The obligate burrowing Antrodiaetid, *Atypoides riversi* (O.P.-Cambridge 1883), is common in the study area, but its burrows have distinct turrets and several branches and are found on steeper forested slopes, so there is no fine-scale range overlap with burrows of *S. mccooki*.

While the prevalence and purpose of burrow use in *S. mccooki* are unclear, its existence in this population is certain. Burrow use has been documented in populations of the very closely related *S. avida* (Dondale & Redner 1990), but in no other congeneric species. It has further been documented in many other genera of wolf spiders in a variety of forms. Depending on the species, burrows can range from deep, silk-lined tubes with protruding turrets to simple, shallow depressions. They may be used by both sexes throughout life or by females of only certain age classes. Wolf spiders may live in and hunt from burrows, they may live in burrows but wander outside in search of prey, or they may use burrows just when molting or constructing an egg sac. Clearly, a great deal of uncertainty remains over this highly variable behavior. Further study is needed to clarify the prevalence and purpose of burrow use in wolf spiders and any implications for lineage evolution.

I thank G. Stratton, P. Cushing, C. McNeely, D. Mott, M. Power, and two anonymous reviewers for helpful suggestions and comments on the manuscript. M. Thomsen pointed out an adult female with egg sac inside a silk-lined burrow, appearing in Figs. 1 & 2. I am grateful to P. Steel and the University of California Natural Reserve System for stewardship and protection of the study site. Female and male voucher specimens of *Schizocosa mccooki* have been deposited in the Essig Museum of Entomology at the University of California, Berkeley.

LITERATURE CITED

Allred, H.A. 1975. Arachnids as ecological indicators. Great Basin Naturalist 35:405–406.



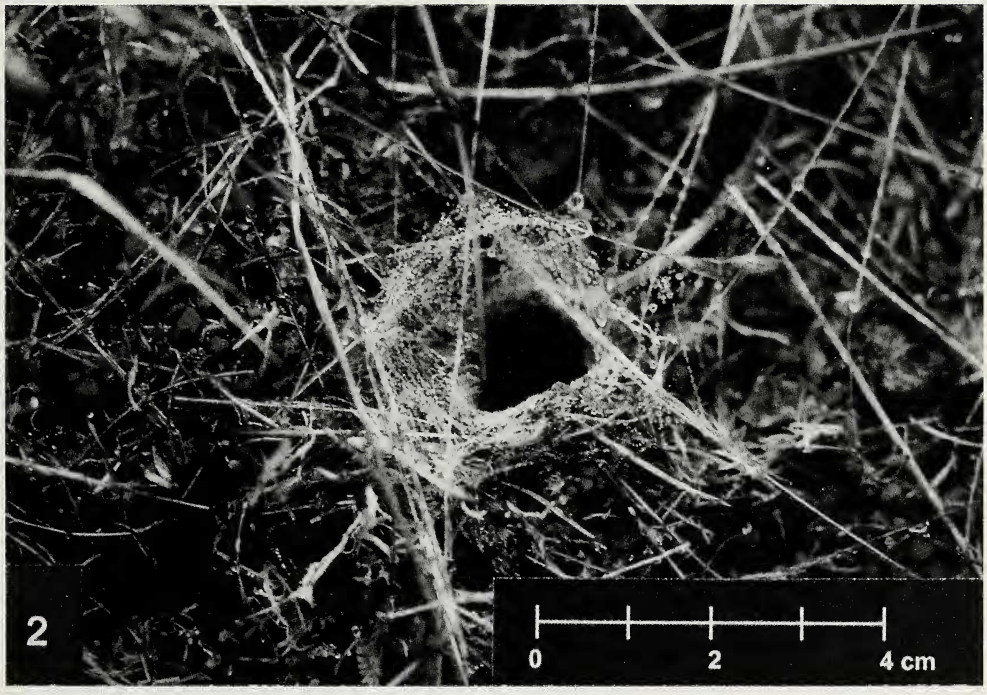


Figure 1.—An adult female with egg sac sits partially concealed in the entrance to her burrow.

Figure 2.—The silk linings of this burrow are made clearly visible by early morning dew.

Brady, A.R. 1986. Nearctic species of the new wolf spider genus Gladicosa (Araneae: Lycosidae). Psyche 93:285–319.

Buckle, D.J. 1972. Sound production in the courtships of two lycosid spiders, *Schizocosa avida* Walckenaer and *Tarentula aculeata* (Clerck). Blue-Jay 30:110–113.

Dondale, C.D. and J.H. Redner. 1978. Revision of the Nearctic wolf spider genus *Schizocosa* (Araneida: Lycosidae). Canadian Entomologist 110: 143–181.

Dondale, C.D. and J.H. Redner. 1990. The wolf spiders, nurseryweb spiders, and lynx spiders of Canada and Alaska (Araneae: Lycosidae, Pisauridae, and Oxyopidae). The Insects and Arachnids of Canada, Part 17.

Emerton, J.H. 1919. The spiders collected by the Canadian Arctic Expedition 1913–1918. Pp. 3H–9H. *In* Expedition 1913–1918. Queen's Printer, Ottawa.

Kaston, B.J. 1972. How to Know the Spiders. WCB/McGraw-Hill, Boston.

Kaston, B.J. 1948. Spiders of Connecticut. Bulletin of the Connecticut State Geological and Natural History Survey 70:1–874.

Montgomery, T.H. 1904. Descriptions of North American Araneae of the families Lycosidae and Pisauridae. Proceedings of the National Academy of Sciences 56:261–323.

Shook, R.S. 1978. Ecology of the wolf spider *Lycosa carolinensis* Walckenaer (Araneae, Lycosidae) in a desert community. Journal of Arachnology 6:53–64.

Stratton, G.E. and D.C. Lowrie. 1984. Courtship behavior and life cycle of the wolf spider *Schizocosa mccooki* (Araneae, Lycosidae). Journal of Arachnology 12:223–228.

Wallace, H.K. 1942. A revision of the burrowing spiders of the genus *Geolycosa* (Araneae: Lycosidae). American Midland Naturalist 27:1–62.

Weeks, R.D. and T.O. Holztzer. 2000. Habitat and season in structuring ground-dwelling spider (Araneae) communities in a shortgrass steppe ecosystem. Environmental Entomology 29: 1164–1172.

Zehethofer, K. and C. Sturmbauer. 1998. Phylogenetic relationships of central European wolf spiders (Araneae: Lycosidae) inferred from 12S ribosomal DNA sequences. Molecular Phylogenetics and Evolution 10:391–398.

Zyuzin, A.A. 1990. Studies on burrowing spiders of the family Lycosidae (Araneae). I. Preliminary data on structural and functional features. Acta Zoologica Fennica 190:419–422.

Manuscript received 18 March 2002, revised 2 October 2002.